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Ronshaugen et al.

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(54) **LAPPING DEVICE WITH LAPPING CONTROL FEATURE AND METHOD**

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B24B 37/30 (2012.01)
B24B 49/00 (2012.01)

(52) **U.S. Cl.**
CPC ***B24B 37/345*** (2013.01); ***B24B 37/30*** (2013.01); ***B24B 49/00*** (2013.01)

(58) **Field of Classification Search**
CPC B24B 37/00; B24B 37/04; B24B 37/10; B24B 37/105; B24B 37/107; B24B 37/27; B24B 37/30; B24B 37/34; B24B 37/345
USPC 451/11, 12, 14, 41, 285, 287, 288
See application file for complete search history.

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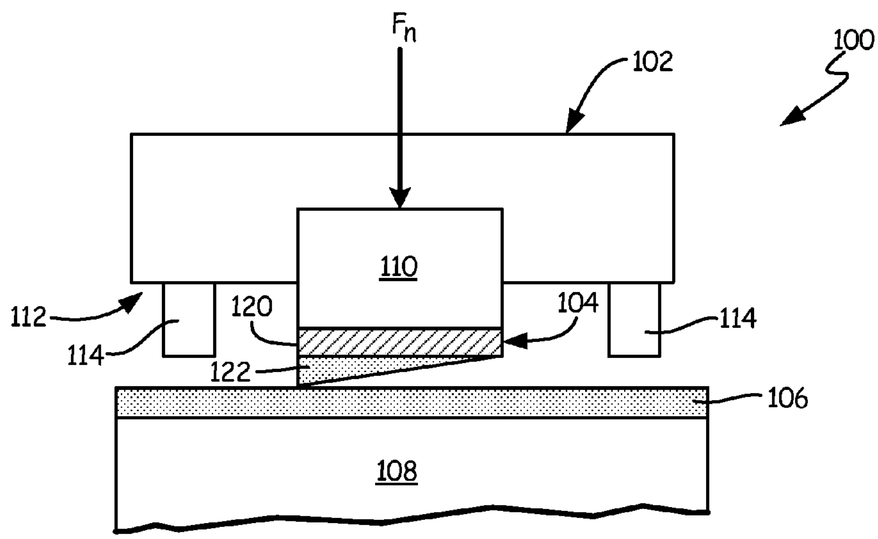
(57) **ABSTRACT**

A head structure for a lapping assembly including a lapping control feature is disclosed. The lapping control feature includes a raised contact surface elevated from a front surface of the head structure of the lapping assembly. A relative position of the workpiece and raised contact surface are aligned to control workpiece thickness and other lapping parameters. In illustrated embodiments, the relative position of the workpiece and raised contact surface are aligned via an adjustment mechanism on the head structure. In illustrated embodiments, the adjustment mechanism is configured to adjust a position of the workpiece relative to the raised contact surface.

13 Claims, 11 Drawing Sheets



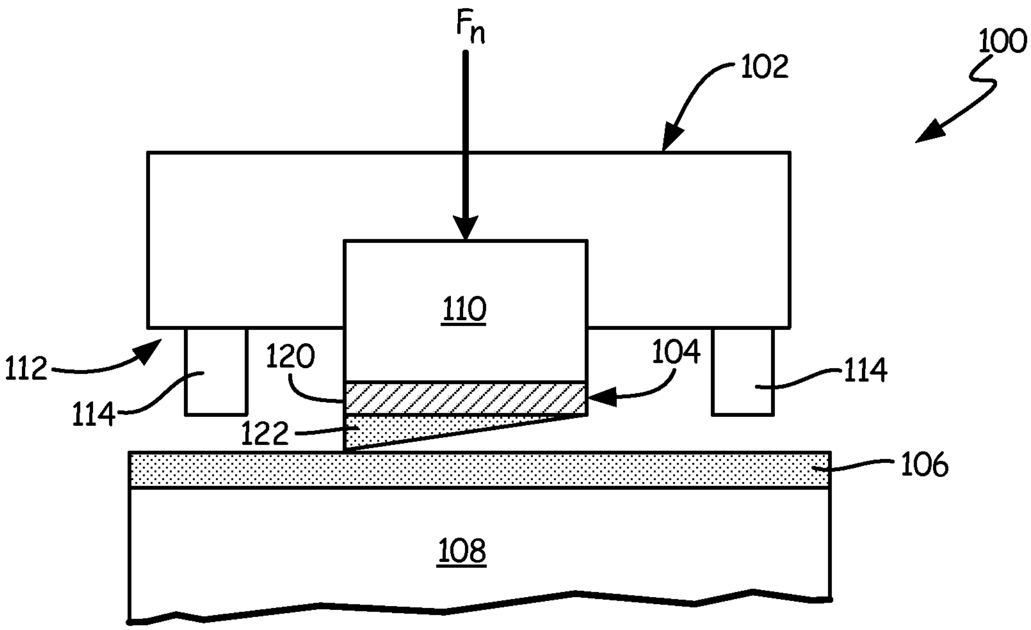
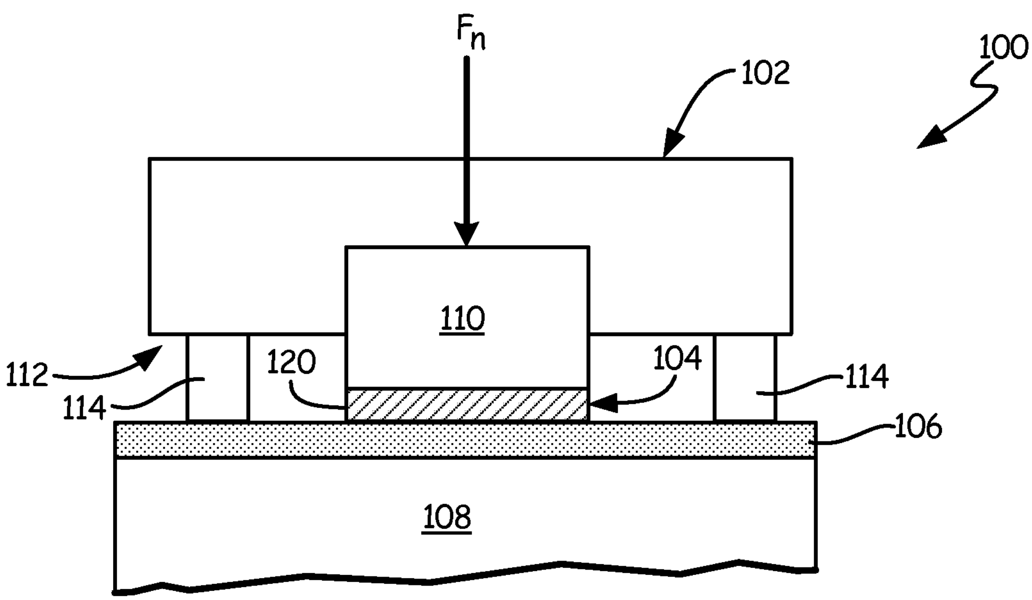

Fn
100
102
110
112
114
120
104
114
122
106
108

Fig. 1A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100
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Fig. 1B

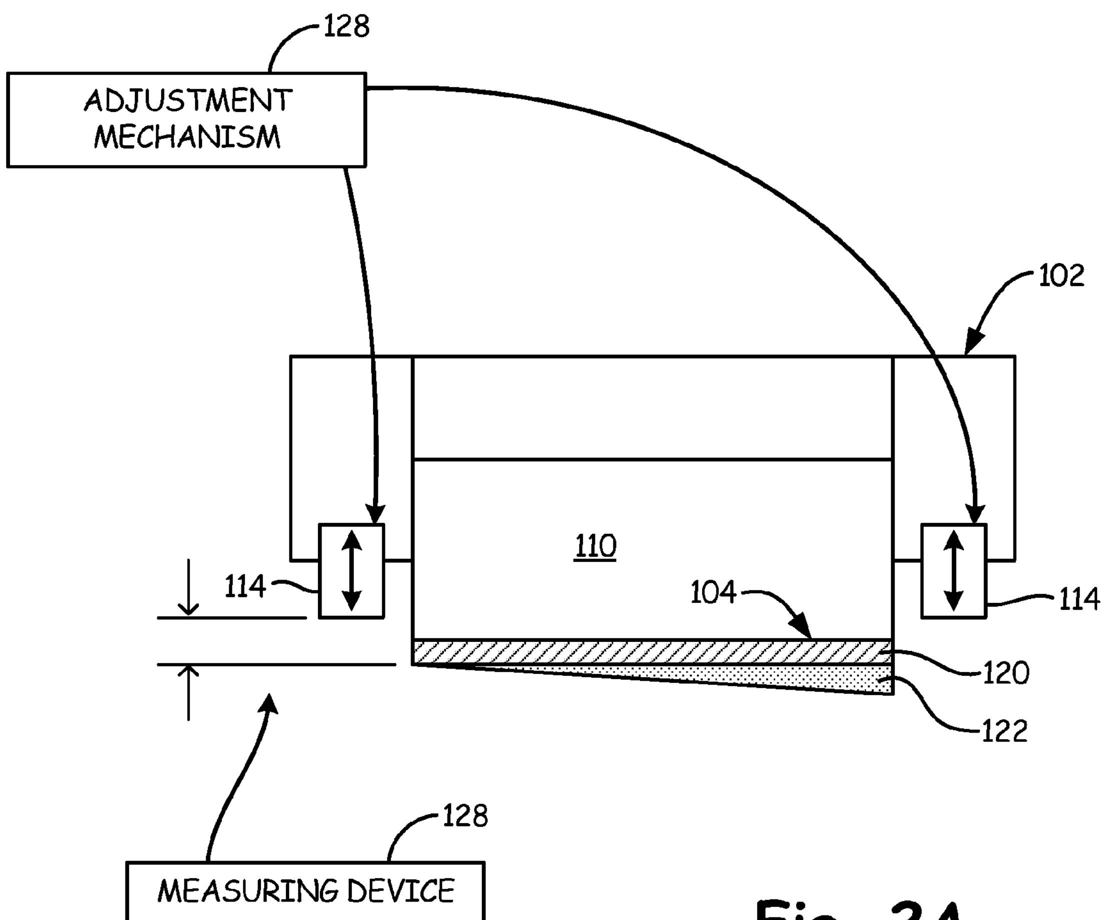
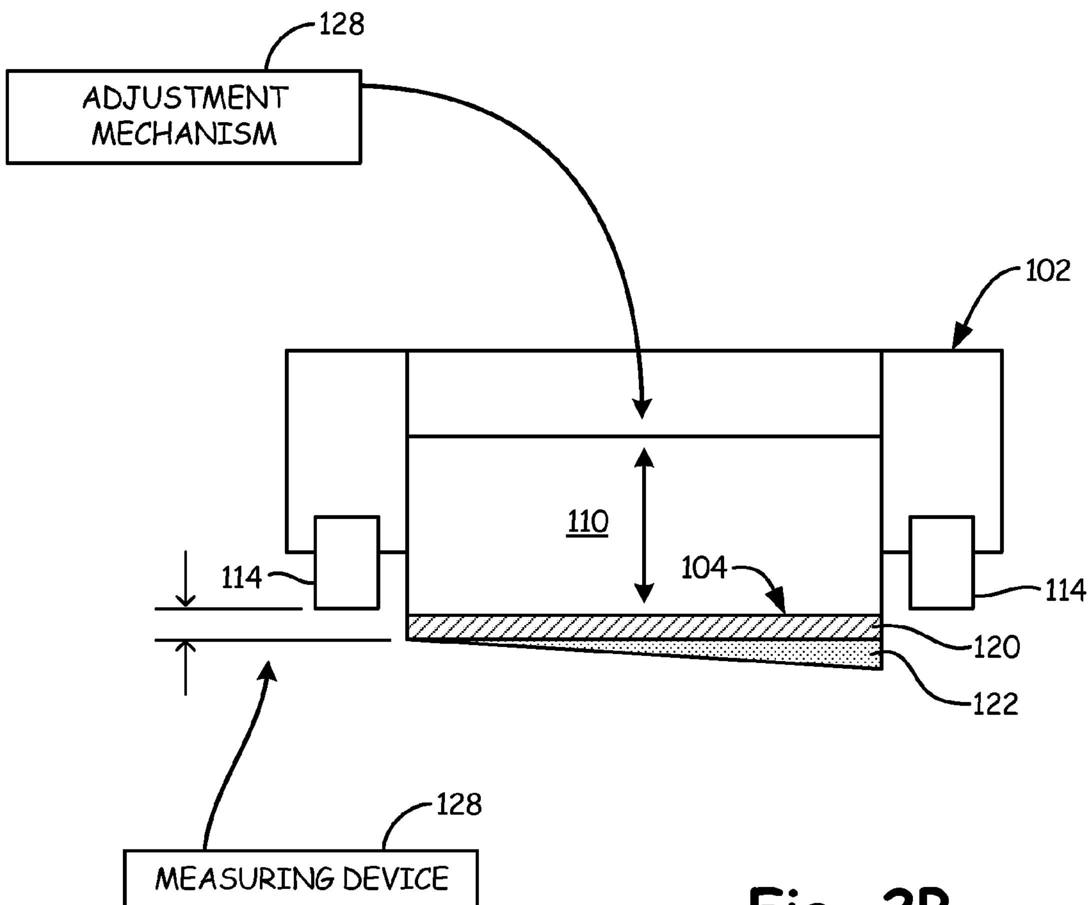

128
ADJUSTMENT MECHANISM
102
110
114
104
114
120
122
128
MEASURING DEVICE

Fig. 2A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ADJUSTMENT MECHANISM
102
110
114
104
114
120
122
128
MEASURING DEVICE

Fig. 2B

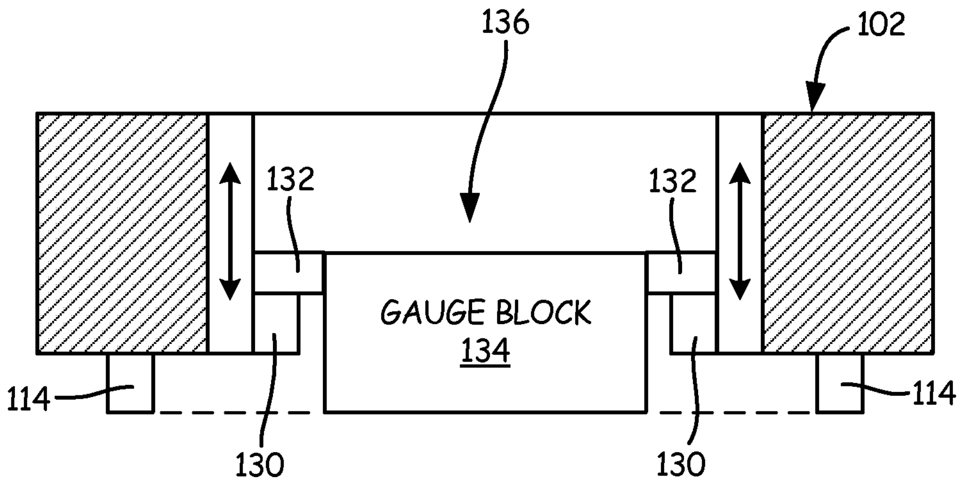

136
102
132
132
GAUGE BLOCK
134
114
114
130
130

Fig. 3A

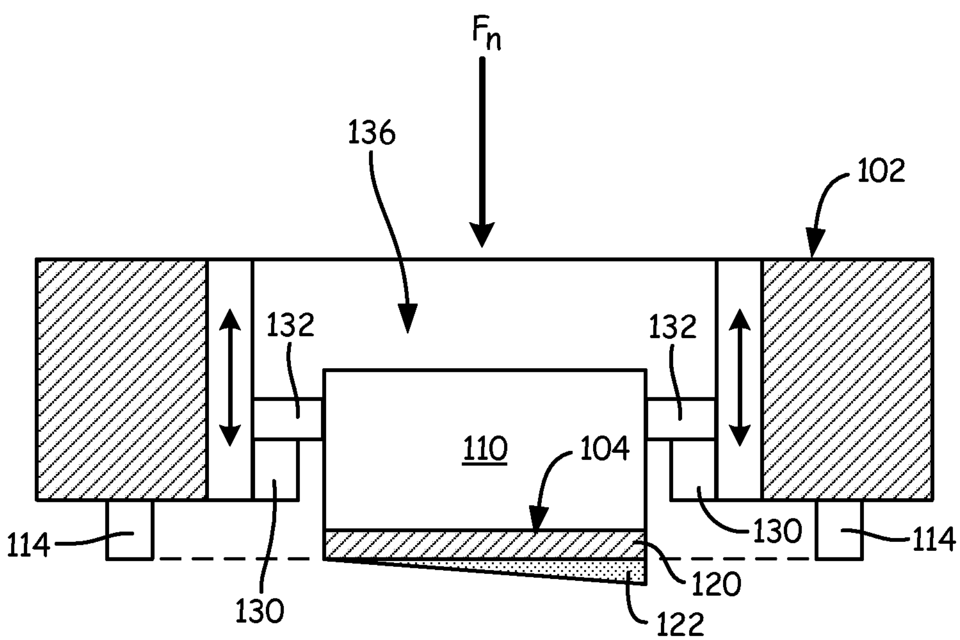

F_n
136
102
132
132
110
104
114
130
114
130
120
122

Fig. 3B

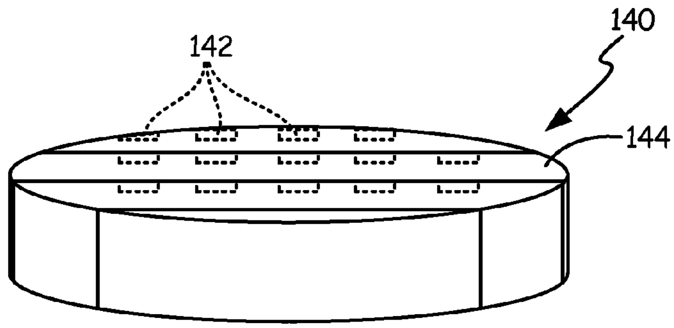


Fig. 4A

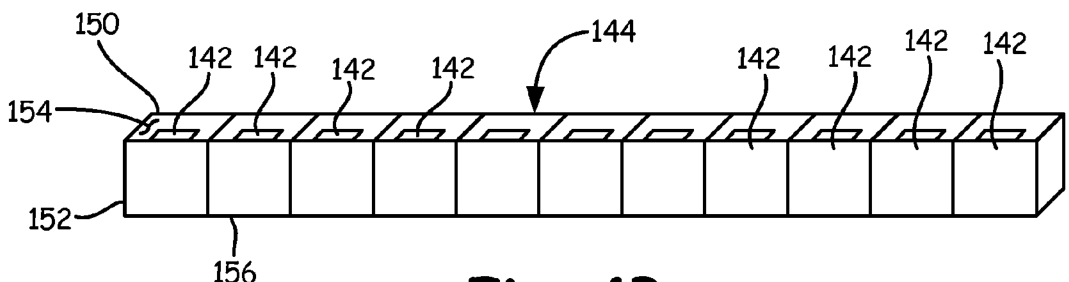


Fig. 4B

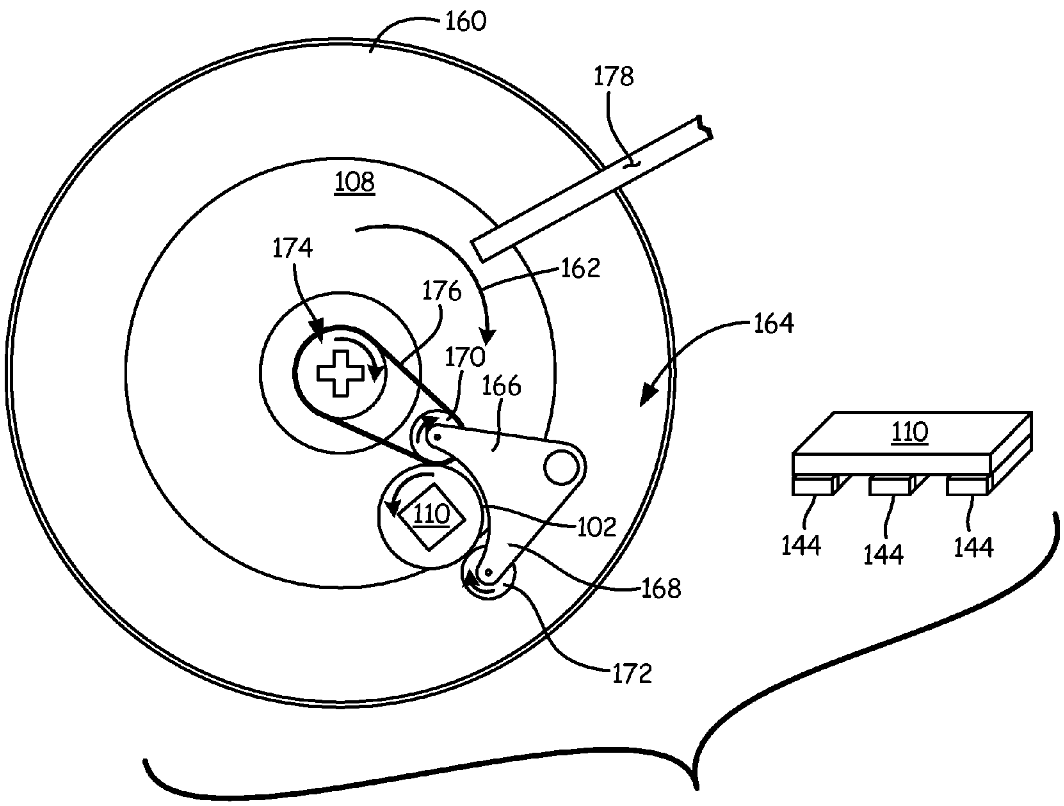

160
178
108
174
176
162
164
170
166
110
102
168
172
110
144
144
144

Fig. 5

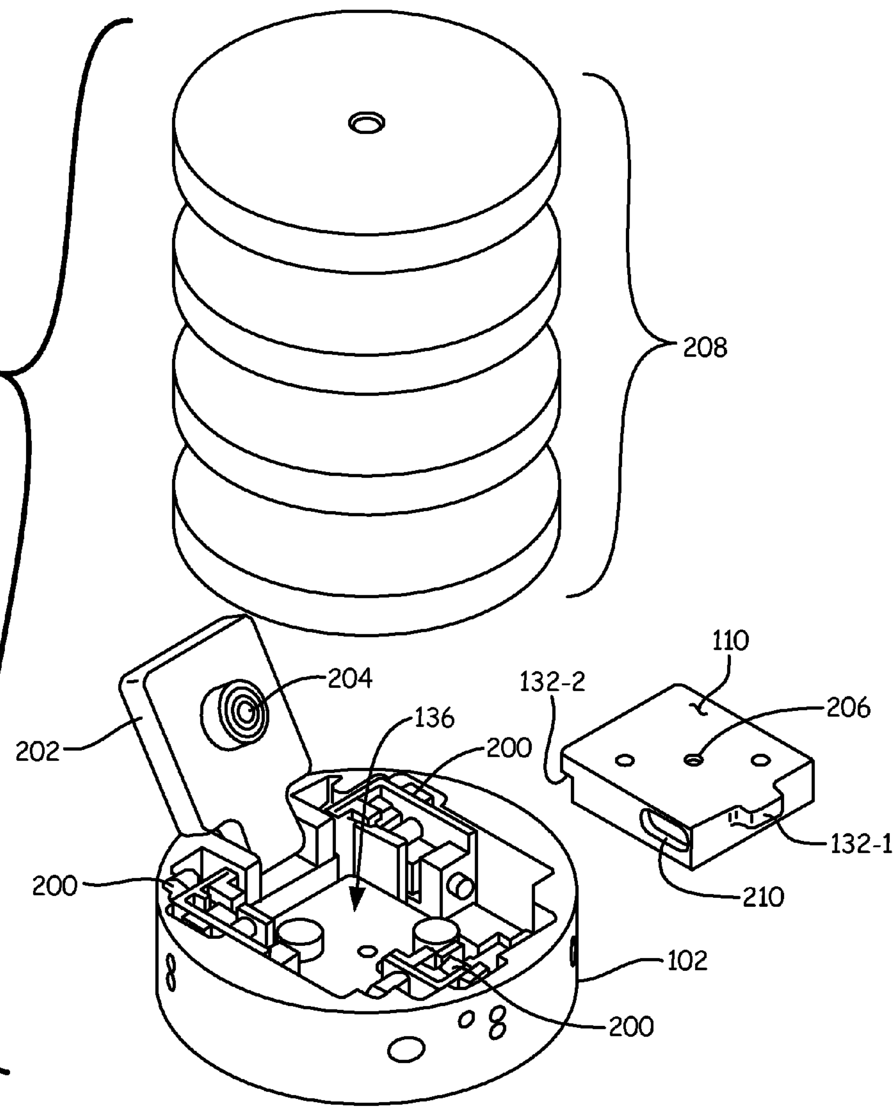


Fig. 6A

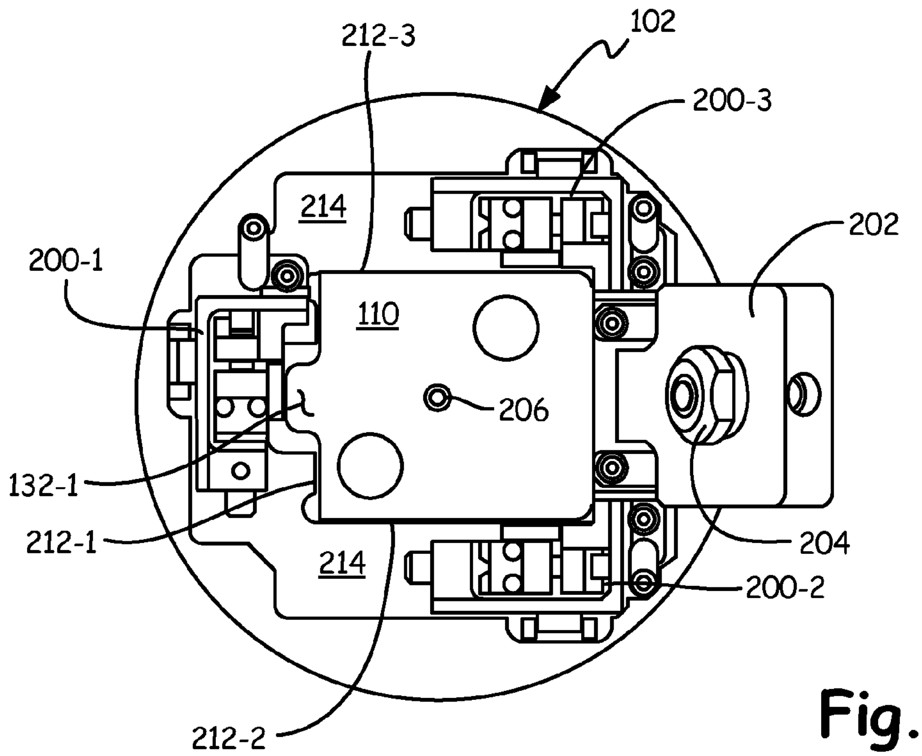
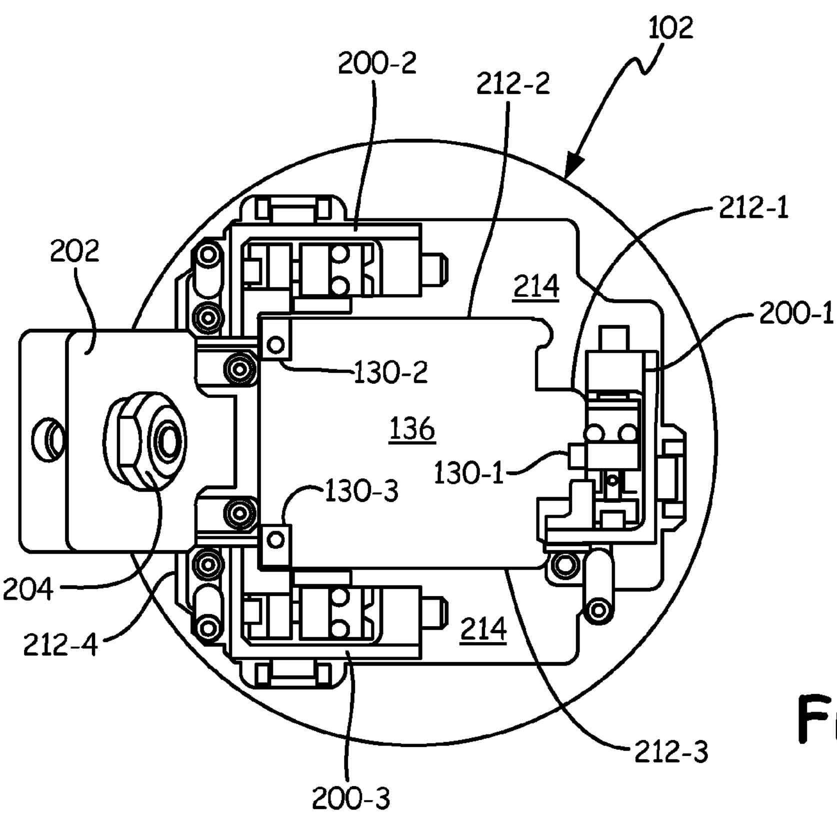

102
212-3
200-3
214
202
200-1
110
206
132-1
212-1
204
214
200-2
212-2

Fig. 6B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200-2
212-2
212-1
202
214
200-1
130-2
136
130-1
130-3
204
212-4
214
212-3
200-3

Fig. 6C

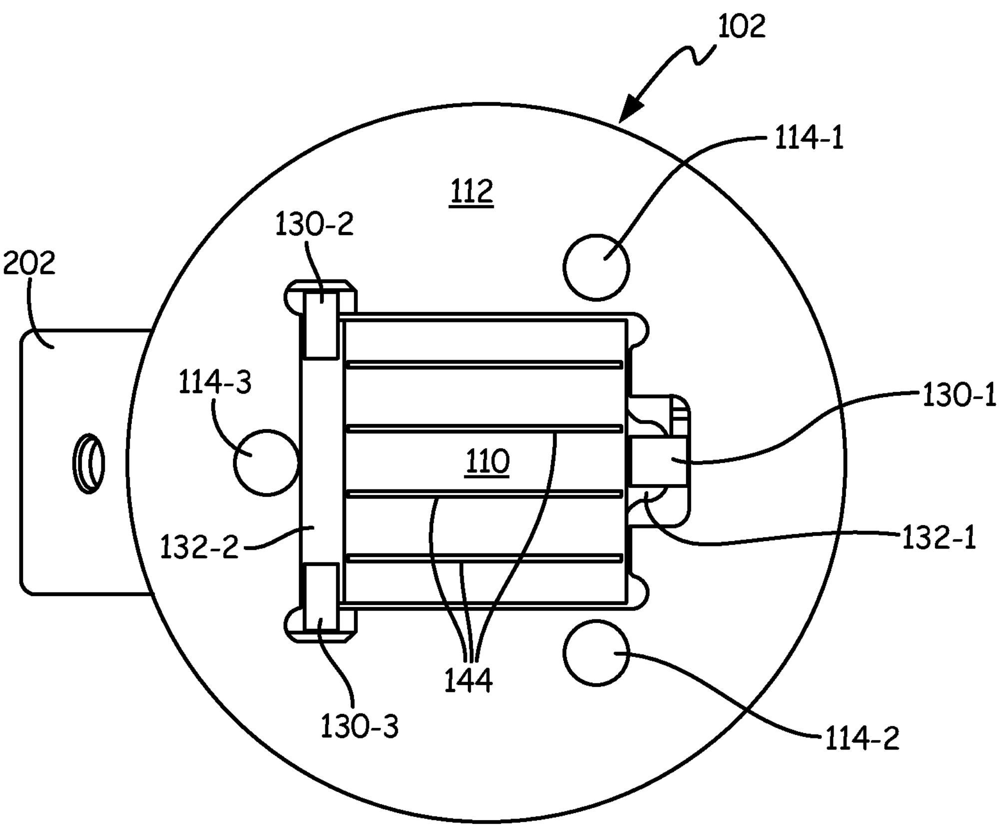
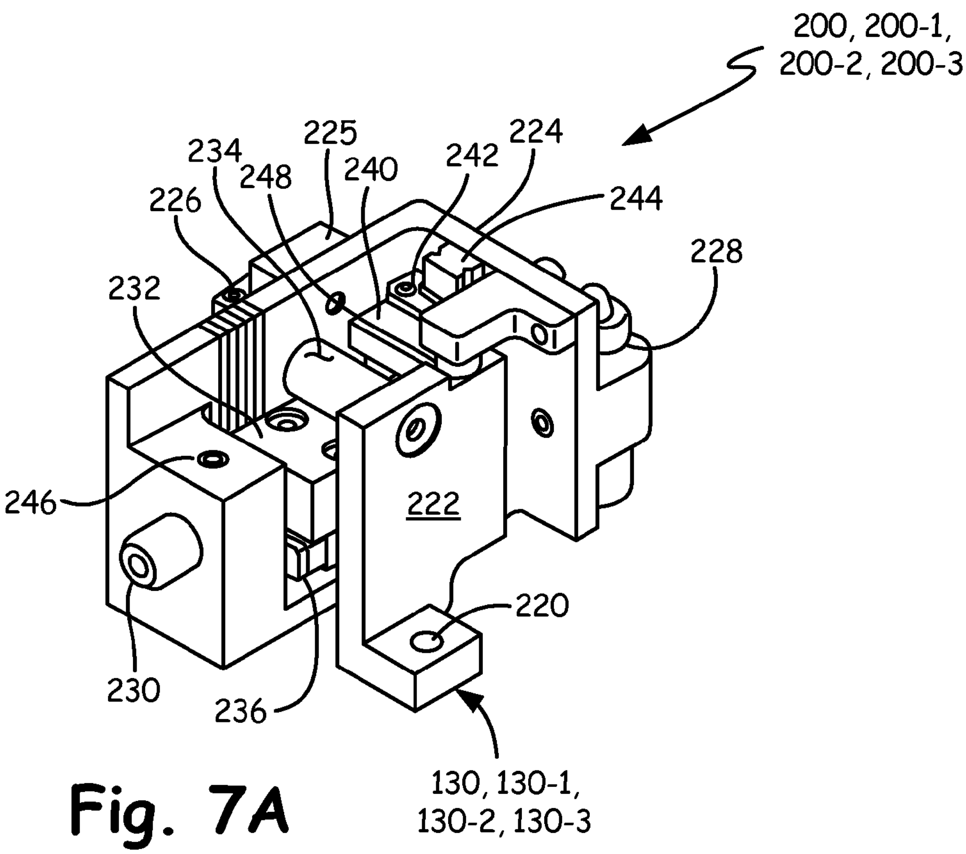


Fig. 6D


200, 200-1,
200-2, 200-3
225
234
248
240
242
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244
226
228
232
246
222
220
230
236
130, 130-1,
130-2, 130-3

Fig. 7A

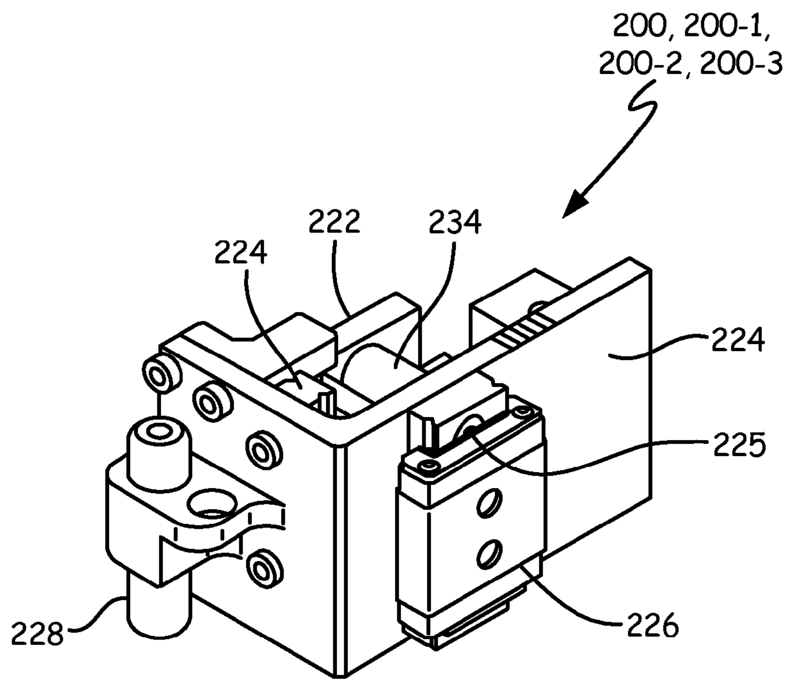
200, 200-1,
200-2, 200-3
222
234
224
224
225
228
226

Fig. 7B

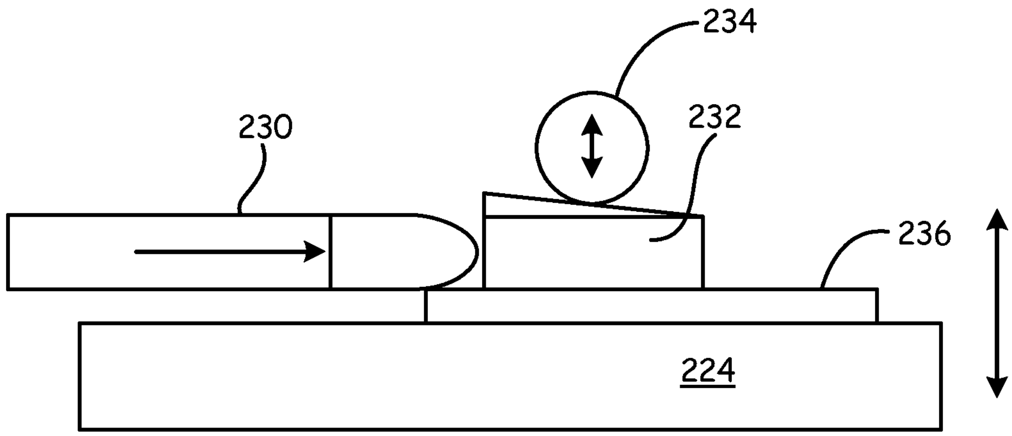
234
230
232
236
224

Fig. 7C

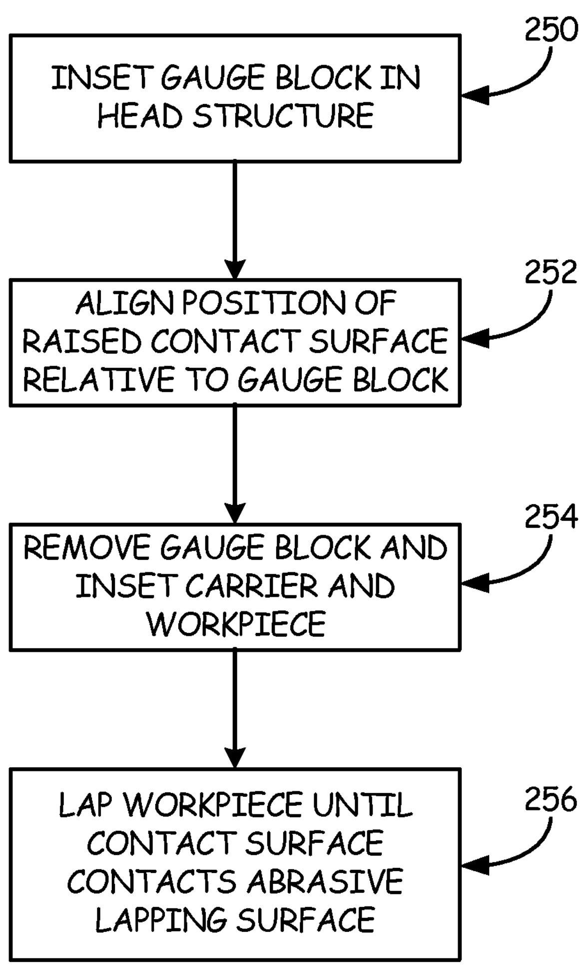
250
INSET GAUGE BLOCK IN HEAD STRUCTURE
252
ALIGN POSITION OF RAISED CONTACT SURFACE RELATIVE TO GAUGE BLOCK
254
REMOVE GAUGE BLOCK AND INSET CARRIER AND WORKPIECE
256
LAP WORKPIECE UNTIL CONTACT SURFACE CONTACTS ABRASIVE LAPPING SURFACE

Fig. 8

LAPPING DEVICE WITH LAPPING CONTROL FEATURE AND METHOD

BACKGROUND

Manufactured components are lapped to remove excess material to control thickness and other parameters of the fabricated components. Illustrative components include slider bars having a row of transducer heads. The bar is lapped to control the taper and bow of the slider bar and the thickness of the individual transducer heads fabricated from the slider bar. During the lapping process, the bar is supported against an abrasive lapping surface. Relative movement between the bar against the abrasive lapping surface removes or abrades a layer of material from the bar. The amount or thickness of the material removed is dependent upon the abrasion of the lapping surface and lapping time. Lapping time is increased to increase the thickness of material removed or the lapping time is decreased to reduce the thickness of material removed. For slider bars or components, a pre-set lapping time is used to control the lapping process and thickness of material removed. Variations in the bar dimensions and parameters can introduce variations in the thickness dimensions of the transducer heads fabricated using the pre-set lapping time. Embodiments of the present invention provide solutions to these and other problems, and offer other advantages over the prior art.

SUMMARY

The application relates to a head structure for a lapping device including a lapping control feature. As described, the lapping control feature includes a raised contact surface elevated from a front surface of the head structure. A relative position of the workpiece and raised contact surface are aligned to control workpiece thickness and other lapping parameters. The relative position of the workpiece and raised contact surface are aligned via an adjustment mechanism on the head structure. In illustrated embodiments, the adjustment mechanism is configured to adjust a position of the workpiece relative to the raised contact surface. In one embodiment described, the position of the workpiece is adjusted by adjusting an elevation of carrier supports that retain a carrier for the workpiece on the head structure. Prior to lapping, the elevation of the carrier supports is adjusted using a gauge block. Utilizing the gauge block, the carrier supports are adjusted so that the raised contact surface is aligned at a desired thickness of the workpiece. In embodiments shown, the raised contact surface on the head structure includes a plurality of contact pads. In illustrated embodiments, the plurality of contact pads are formed of a ceramic material or other material similar to the workpiece.

Other features and benefits that characterize embodiments of the present invention will be apparent upon reading the following detailed description and review of the associated drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1**A and **1**B schematically illustrate a lapping structure including a lapping control feature for controlling lapping parameters for lapping a workpiece.

FIGS. **2**A-**2**B illustrate embodiments of a lapping structure including an adjustment mechanism for adjusting a relative position of a workpiece and the lapping control feature.

FIGS. **3**A-**3**B illustrate an embodiment of the lapping structure including an adjustment mechanism for adjusting a position of carrier supports relative to the lapping control feature to control the lapping parameters or thickness of the workpiece.

FIGS. **4**A-**4**B illustrate transducer head components including a slider bar shown in FIG. **4**B cut from a wafer structure shown in FIG. **4**A.

FIG. **5** illustrates an embodiment of a lapping device including a head structure having the lapping control feature for controlling the lapping parameters for fabricating head components illustrated in FIGS. **4**A-**4**B.

FIGS. **6**A-**6**D illustrate an embodiment of the head structure including adjustable carrier supports for adjusting the relative position of the workpiece and the lapping control feature where FIG. **6**A illustrates the head structure in a top perspective view, FIG. **6**B illustrates the head structure in a top plan view with a carrier inset in the head structure for supporting the workpiece, FIG. **6**C illustrates the head structure in top plan view with the carrier removed and FIG. **6**D illustrates a bottom plan view of the head structure and the lapping control feature.

FIGS. **7**A-**7**B illustrate an embodiment of an adjustment mechanism for adjusting the position of the carrier supports for the workpiece relative to the lapping control feature.

FIG. **7**C schematically illustrates a threaded drive rod and wedged shaped block for adjusting a position of the carrier supports relative to a support block of the adjustment mechanism.

FIG. **8** illustrates a lapping process utilizing the lapping control feature on the head structure. It should be understood that the attached drawings are not necessarily drawn to scale and that certain features may be exaggerated for clarity.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

The present application relates to a lapping assembly **100** or process utilizing a lapping control feature. Embodiments of the lapping assembly **100** or process disclosed have application for lapping miniature components such as a slider bar for fabrication of transducer heads for data storage devices. Although embodiments of the present application are described for lapping slider bars for fabrication of transducer heads, application is not limited to slider bars and embodiments of the lapping control feature described in the application can be implemented to control thickness or dimensions for other workpieces.

FIGS. **1**A-**1**B illustrate an embodiment of the lapping assembly **100** having the lapping control feature to control lapping parameters or dimensions of a workpiece. As schematically illustrated in FIGS. **1**A-**1**B, the lapping assembly **100** includes a head structure **102** that supports a workpiece **104** for lapping. The head structure **102** moves (or rotates) relative to an abrasive lapping surface **106** to abrade a surface layer of material from the workpiece **104**. As shown, the abrasive lapping surface **106** is formed of an abrasive material or surface on an outer surface of a rotating platen **108**. In an illustrated embodiment, relative motion between the workpiece **104** and abrasive lapping surface **106** is imparted via rotation of both the platen **108** and the head structure **102** supporting the workpiece **104**, however application is not limited to rotation of both the platen **108** and head structure **102**, and in illustrative embodiments, one of the head structure **102** or platen **108** rotates to engage the workpiece **104** along the abrasive lapping surface **106**.

As shown in FIGS. **1**A-**1**B, the workpiece **104** is coupled to the head structure **102** through a carrier **110**. The workpiece **104** and carrier **110** form a carrier/workpiece unit which is coupled to and supported by the head structure **102** for lapping. During the lapping process, a force F_n is applied to the carrier/workpiece unit to bias the workpiece **104** towards the abrasive lapping surface **106**. The relative movement of the workpiece **104** and abrasive lapping surface **106** abrades material generally at a lapping rate dependent upon the workpiece material, abrasion of the abrasive lapping surface **106** and lapping time. For small or miniature components, such as a slider bar or transducer head, precise control of the lapped thickness and the lapping process is important to reduce tolerance variations. In the embodiment shown in FIGS. **1A-1B**, the head structure **102** includes a raised contact surface elevated from a front surface **112** of the head structure **102** to form the lapping control feature. In the embodiment shown, the raised contact surface includes one or more contact pads, such as the pair of contact pads **114** illustrated in FIGS. **1A-1B**.

Prior to lapping, the workpiece **104** includes a gauge thickness **120** and an additional thickness **122**. The gauge thickness **120** corresponds to a desired thickness of the workpiece **104** and the additional thickness **122** corresponds to the thickness to be removed by the lapping process. The one or more contact pads **114** and workpiece **104** are aligned to remove the additional thickness **122** during the lapping process but not the gauge thickness **120**. Thus, as comparatively illustrated in FIGS. **1A-1B**, during the lapping process, the additional thickness **122** is progressively removed until the raised contact surface or contact pads **114** engage or contact the abrasive lapping surface **106** as shown in FIG. **1B**. Contact between the abrasive lapping surface **106** and the raised contact surface or pads **114** inhibits further material removal from the workpiece **104** to control the lapped thickness of the workpiece **104** to correspond to the gauge thickness **120**.

In an illustrated embodiment, the one or more contact pads **114** are formed of a similar material to the workpiece **104**. For example if the workpiece is a ceramic slider bar, the one or more contact pads **114** are formed of a ceramic material. Force F_n is supplied to bias the workpiece **104** against the abrasive lapping surface **106** and distribute load across the workpiece **104** to provide a uniform thickness and flatness. As shown in FIG. **1B**, as the lapped workpiece **104** reaches the gauge thickness **120** and the raised contact surface or pads **114** contact the abrasive lapping surface **106**, the lapping force is transferred to the raised contact surface or pads **114** to reduce the lapping force applied to the workpiece **104**. The reduced lapping force or pressure following contact provides a uniform workpiece thickness, and more uniform shape, stress and surface finish along the workpiece **104**.

As schematically illustrated in FIGS. **2A-2B**, the raised contact surface or one or more contact pads **114** and workpiece **104** are aligned by either adjusting the position of the one or more contact pads **114** with respect to the workpiece **104** through adjustment mechanism **126** coupled to the contact pads **114** as schematically illustrated in FIG. **2A** or by adjusting the position of the workpiece **104** with respect to the raised contact surface or pads **114** via adjustment mechanism **126** coupled to the workpiece **104** as schematically illustrated in FIG. **2B**. In the illustrated embodiments, a measuring device **128** is used to adjust the relative position of the one or more contact pads **114** and the workpiece **104** as shown in FIGS. **2A-2B**. In an illustrative embodiment, the measurement device **128** is an optical or laser measuring device. Based upon the measured position, the position of the workpiece **104** or pads **114** is adjusted by positioning mechanisms **126** so that the one or more contact pads **114** inhibit lapping below the gauge thickness **120** of the workpiece **104** as previously described.

FIGS. **3A-3B** illustrate an embodiment of the adjustment mechanism configured to adjust the position of the workpiece **104** relative to the one or more contact pads **114** through adjustment of the carrier **110** relative to the head structure **102**. As shown, the head structure **102** includes one or more adjustable carrier supports **130**. The carrier supports **130** as shown provide support surfaces for one or more support projections **132** extending from a gauge block **134** shown in FIG. **3A** for alignment and support projections **132** extending from a main body of the carrier **110** shown in FIG. **3B** for lapping. As shown, the carrier supports **130** are vertically adjustable to adjust the vertical position of the carrier support **130** and thus the elevation of the carrier/workpiece unit relative to the one or more contact pads **114** utilizing the gauge block **134**.

In the illustrated embodiment shown in FIGS. **3A-3B**, the carrier supports **130** extend into an opening **136** of the head structure **102**. Opening **136** is sized to receive the gauge block **134** shown in FIG. **3A** and the carrier/workpiece unit shown in FIG. **3B**. Carrier supports **130** extend into the opening **136** to restrict passage of the gauge block **134** and carrier **110** therethrough. Prior to lapping, the gauge block **134** is used to adjust the elevation of the carrier supports **130** for lapping. The gauge block **134** is formed of a solid body having a height that corresponds to the height of the carrier **110** and gauge thickness **120** of the workpiece **104**. The elevation of the carrier supports **130** is adjusted until a front surface of the gauge block **134** aligns with a front surface of the contact pads **114** as shown in FIG. **3A**. In an illustrated embodiment, the gauge block **134** is formed of a gold standard block to precisely align the carrier supports **130** for lapping.

Once the carrier supports **130** are aligned utilizing the gauge block **134**, the carrier/workpiece unit is inserted into the opening **136** so that the support projections **132** on the carrier **110** rest on the carrier supports **130** for lapping as illustrated in FIG. **3B**. During the lapping process, force F_n is applied to the carrier **110** to bias the support projections **132** against the carrier supports **130** to secure the carrier **110** to the head structure **104** for lapping and bias the workpiece **104** against the abrasive lapping surface **106**. As previously described, in an alternate embodiment, the position of the one or more contact pads **114** or raised contact surface is adjusted to implement the lapping control feature to control the lapping parameters of the workpiece and application is not limited to the embodiment shown in FIGS. **3A-3B**.

The lapping structure described is used to lap components for transducer heads for data storage devices. As shown in FIG. **4A**, transducer heads are typically fabricated on a wafer substrate **140**. Transducer elements **142** (illustrated diagramatically) of the heads are deposited or formed on a surface of the wafer substrate **140** using thin film deposition techniques. Following deposition of the transducer elements **142**, the wafer **140** is sliced into bars **144** as shown in FIG. **4B**. The sliced bars **144** have a leading edge **150**, a trailing edge **152**, air bearing surface **154** and a back surface **156**. Slider bars **144** are lapped to control the thickness of the bar as well as to enhance flatness, bow and perpendicularism of the air bearing surface **156** and back surface **158** of the bar **144**. The lapped bar **144** is then sliced to form the individual transducer heads of the data storage device.

FIG. **5** illustrates an embodiment of a lapping assembly utilizing the head structure **102** with the lapping control feature described (not shown in FIG. **5**). The device includes the platen **108** (and abrasive lapping surface) disposed in a container **160**. The platen **108** is rotated relative to the base of the container **160** as illustrated by arrow **162** via a motor (not shown). The head structure **102** is supported on the abrasive lapping surface **106** of the platen **108** and is retained on the platen surface by a fixture **164** connected to the base of the container **160**. As shown, fixture **164** is V shaped to form multiple arms **166**, **168** spaced to form an opening for the head structure **102**. The head structure **102** is supported in the opening between rollers **170**, **172** rotationally coupled to the distal end of arms **166**, **168**, respectively. The head structure **102** is rotated through a rotating shaft **174** disposed in the container **160**.

Rotation of the shaft **174** is transmitted to the head structure **102** through a transmission line **176** connecting the rotating shaft **174** to roller **170**. Rotation of shaft **174** rotates roller **170** to impart rotation to the head structure **102**. Thus, in the illustrated embodiment, roller **170** forms a powered roller and roller **172** forms a passive roller. In the embodiment shown, shaft **174** rotates in unison with platen **108** through the motor (not shown). As schematically shown, lubricant is supplied from a supply line **178** for lapping. As schematically shown in FIG. **5**, multiple bars **144** are connected to the carrier **110**, which is coupled to the head structure **102** for lapping as previously described.

FIGS. **6**A-**6**D illustrate a detailed embodiment of a head structure **102** with adjustable carrier supports **130** (visible in FIG. **6**C) to adjust the position of the workpiece **104** relative to the raised contact surface or pads **114**. As shown in FIGS. **6**A-**6**C, the head structure **102** includes the carrier supports **130** (not shown in FIGS. **6**A-**6**B) extending into opening **136** and adjustable through adjustment mechanisms **200** along sides of the opening **136**. As shown, a weight applicator plate **202** is pivotally coupled to the head structure **102** to pivot between an open position and a closed position (not shown). In the open position shown in FIGS. **6**A-**6**C, the opening **136** is accessible to inset the carrier **110** or gauge block **134** and in the closed position a ball plunger **204** on the plate **202** is biased against the carrier **110** within a ball socket **206** on the carrier **110**.

As shown in FIG. **6**A, one or more weights **208** are supported on the load applicator plate **202** in the closed position to bias the carrier **110** against the carrier supports **130** to retain the carrier **110** in the head structure **102** for lapping. The one or more weights **208** evenly distribute the lapping force to provide a uniform thickness and stress along a length of the workpiece as described. In the embodiment shown, the carrier **110** includes two support projections **132-1**, **132-2** extending from opposed ends of the carrier **110** to engage the carrier supports **130** for lapping. In an illustrated embodiment, the gauge block **134** has a similar construction and projections **132-1**, **132-2** as the carrier **110** for alignment of the workpiece **104** and raised contact surface or pads **114**. The carrier **110** (and gauge block **134**) also includes handles **210** along sides of the carrier **110** to grab the carrier **110** to insert the carrier **110** into opening **136** of the head structure **102** for lapping.

FIG. **6**B illustrates the head structure **102** with the carrier inset in opening and FIG. **6**C illustrates the head structure with the carrier **110** removed. As shown in FIG. **6**B-**6**C, opening **136** extends through the body **180** of the head structure **102** and forms sides **212-1**, **212-2**, **212-3**, **212-4** enclosing the opening **136**. In the illustrated embodiment shown in FIG. **6**C, the carrier **110** includes three carrier supports **130-1**, **130-2**, **130-3** that engage support projections **132-1**, **132-2** on carrier **110** and gauge block **134** (not shown). In the illustrated embodiment, carrier support **130-1** is formed along side **212-1**. Carrier support **130-2** is formed along side **212-2** at the corner of side **212-2** with side **212-4** and carrier support **130-3** is formed along side **212-3** at the corner of side **212-3** and **212-4**. In the illustrated embodiment, each of the carrier supports **130-1**, **130-2**, **130-3** is separately adjustable through multiple adjustment mechanisms **200-1**, **200-2**, **200-3**. As shown in FIG. **6**C, carrier support **130-1** is adjusted through adjustment mechanism **200-1** supported on ledge **214** along side **212-1**. Carrier support **130-2** is adjusted through adjustment mechanism **200-2** along ledge **214** of side **212-2** and carrier support **130-3** is adjusted through adjustment mechanism **200-3** along ledge **214** of side **212-3**.

FIG. **6**D illustrates a front surface **112** of the head structure **102** which as shown includes three contact pads **114-1**, **114-2**, **114-3**. Carrier support **130-1** is spaced between contact pads **114-1**, **114-2** at a first end of the carrier **110** and contact pad **114-3** is placed between carrier supports **130-2**, **130-3** at a second end of the carrier **110**. As shown, slider bars **144** are attached to the front surface **112** of the carrier **110** so that the ends of the bars **144** align with the ends of the carrier **110**. As shown contact pads **114-1**, **114-2** are disposed at the first end of the carrier and contact pad **114-3** is disposed at the second end of the carrier **110** to form mechanical end points for lapping the length of the bars extending between the mechanical end points. Contact pads **114-1**, **114-2**, **114-3** shown in FIG. **6**D can be attached to the head structure **102** through an adhesive or other attachment and can be removed and replaced depending upon wear. In the illustrated embodiment, the contact pads **114-1**, **114-2**, **114-2** are round, however, application is not limited to round contact pads and alternate shaped pads can be utilized. In the illustration shown, only four slider bars **144** are shown on the carrier **110**, however, application is not limited to four bars **144** and some carriers are design to hold as many as 44 bars.

FIGS. **7**A-**7**C illustrate an embodiment of the adjustment mechanisms **200**, **200-1**, **200-2**, **200-3** for adjusting the elevation of the individual carrier supports **130**, **130-1**, **130-2**, **130-3** on the head structure **102**. As shown, the carrier supports **130**, **130-1**, **130-2**, **130-3** include a contact ball **220** and are coupled to a bracket **222** which connects the carrier supports **130**, **130-1**, **130-2**, **130-3** to a support block **224**. Support block **224** is coupled to the head structure **102** through a rail assembly including an inner rail **225** connected to the support block **224** and an outer rail **226** connected to the head structure **102** to raise and lower the support block **224** relative to the head structure **102**.

The elevation of the support block **224** is adjusted relative to the head structure **102** through an actuator device which as shown includes a threaded drive rod **228** coupled to the head structure **102** to form one or more drive components to raise and lower the carrier supports **130**, **130-1**, **130-2**, **130-3** through the support block **224**. As shown, support block **224** includes a proximal portion, a distal portion and a side portion extending from a base of the block **224**. The carrier supports **130**, **130-1**, **130-2**, **130-3** are also raised and lowered through one or more drive components coupled to the support block **224** through one or more linkage component operably connecting the drive components on the support block **224** to the carrier support **130**, **130-1**, **130-2**, **130-3**.

In the illustrated embodiment, the one or more drive components on the support block **224** includes a threaded drive rod **230** coupled to a wedge shaped actuator block **232**. The threaded drive rod **230** and wedged shaped actuator block **232** form an actuator device to raise and lower the carrier supports **130**, **130-1**, **130-2**, **130-3** relative to the support block **224**. The drive rod **230** is moved between a retracted position and an extended position to move the wedged shaped actuator block **232** to raise and lower the carrier supports **130**, **130-1**, **130-2**, **130-3**. In illustrated embodiments, the one or more linkage components include a linkage pin **234** coupled to the bracket **222**. Movement of the wedge shaped block **232** engages the pin **234** along the sloped surface of the wedge shaped block **232** as shown in FIG. **7**C to raise and lower the carrier supports **130**, **130-1**, **130-2**, **130-3** through connection of the pin **234** to the bracket **222** as shown in FIG. **7**A. As shown in FIG. **7**A, the wedge shaped block **232** is coupled to and movable along the base of support block **224** through a rail assembly **236**.

In the illustrated embodiment, the bracket **222** is moveably coupled to support block **224** through a rail assembly coupled to a rail extension **240** on bracket **222** and the support block **224**. The rail assembly includes an outer rail **242** coupled to the rail extension **240** and an inner rail **244** coupled to the support block **224**. Movement of the pin **234** via the wedge shaped block **232** raises and lowers bracket **222** via movement of outer rail **242** coupled to bracket **222** along inner rail **224** connected to the support block **224** to raise and lower the carrier supports **130**, **130-1**, **130-2**, **130-3**. In an illustrated embodiment, a spring (not shown) biases the wedge shaped block **232** toward the distal portion of the support block **224**.

As shown, rotation of the drive rod **230** is controlled through a set screw **246** in support block **224**. Support block **224** includes a compressible body **248** that engages extension **240** of bracket **222** to control adjustment of the carrier support **130**, **130-1**, **130-2**, **130-3** via drive rod **230** and wedged shape block **232**. As previously discussed, the elevation of the support block **224** relative to the head structure **102** is adjustable via drive rod **228** coupled to the head structure **102** to provide the one or more drive component to raise or lower the elevation of the support block **224** (and carrier supports **130**, **130-1**, **130-2**, **130-3** coupled to the support block **224**) and operation of the threaded drive rod **230** provides drive components for finely adjusting the elevation of carrier supports **130**, **130-1**, **130-2**, **130-3** relative to the lapping control feature.

FIG. **8** illustrates an embodiment of lapping process steps utilizing the lapping control feature to control the lapping process and parameters. As shown in FIG. **8**, in step **250**, the gauge block **134** is inset into the head structure **102** and the relative position of the raised contact surface or pad **114** and workpiece **104** are aligned in step **252** to provide contact between the raised contact surface and the abrasive lapping surface at the gauge or desired thickness of the workpiece **104**. In embodiments described, the relative position of the raised contact surface and workpiece are aligned by adjusting the carrier support **130** for the carrier **110** holding the workpiece **104** on the head structure **102**. The carrier supports **130**, **130-1**, **130-2**, **130-3** are raised or lowered to adjust the elevation of the gauge block **134** so that the workpiece **104** is lapped to the gauge thickness **120** provided by the gauge block **134**.

In an illustrated embodiment, the carrier supports **130**, **130-1**, **130-2**, **130-3** are aligned utilizing the gauge block **134** while the head structure **102** is supported on a granite block to provide measurement and placement precision. Once the relative position is set, the gauge block **134** is removed in step **254** and the workpiece **104** and carrier **110** are inset into the head structure **102** and the head structure and/or platen is rotated to lap or abrade a surface layer of the workpiece **104**. The workpiece **104** is lapped as shown in step **256** until the raised contact surface contacts the abrasive lapping surface **106** at the desired workpiece thickness.

It is to be understood that even though numerous characteristics and advantages of various embodiments of the invention have been set forth in the foregoing description, together with details of the structure and function of various embodiments of the invention, this disclosure is illustrative only, and changes may be made in detail, especially in matters of structure and arrangement of parts within the principles of the present invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed. For example, the particular elements may vary depending on the particular application or workpiece while maintaining substantially the same functionality without departing from the scope and spirit of the present invention. In addition, although the preferred embodiment described herein is directed to lapping a slider bar, it will be appreciated by those skilled in the art that the teachings of the present invention can be applied to other miniature components or workpieces, without departing from the scope and spirit of the present invention.

What is claimed is:

1. A lapping assembly comprising:

a head structure configured to support a workpiece for lapping;

at least one contact pad on the head structure; and

an adjustment mechanism on the head structure configured to adjust a relative position of the workpiece and the at least one contact pad, the adjustment mechanism comprising;

one or more adjustable carrier supports to support the workpiece on the head structure through a carrier including one or more support projections; and

one or more drive components including a threaded drive rod operable to move a wedged shape block along a rail, wherein the wedge shaped block includes a sloped surface configured to engage a linkage pin coupled to the one or more carrier supports to raise and lower the one or more carrier supports relative to the at least one contact pad.

2. The lapping assembly of claim **1** wherein the head structure includes at least three contact pads extending from a front surface of the head structure.

3. The lapping assembly of claim **1** wherein the at least one contact pad is formed of a ceramic material.

4. The lapping assembly of claim **1** and further comprising a weight applicator plate coupled to the head structure including a ball plunger configured to engage the carrier for the workpiece to bias the carrier and the workpiece towards an abrasive lapping surface.

5. A lapping assembly comprising:

a head structure including a raised contact surface; and

an adjustment mechanism configured to incrementally adjust a relative position of the raised contact surface and a workpiece coupled to the head structure,

wherein the workpiece is coupled to the head structure through a carrier supported on one or more adjustable carrier supports coupled to the head structure through a support block movably coupled to the head structure through a rail assembly, and

wherein the adjustment mechanism includes an actuator device configured to adjust an elevation of the support block relative to the head structure.

6. The lapping assembly of claim **5** wherein the raised contact surface includes a plurality of contact pads elevated from a front surface of the head structure.

7. The lapping assembly of claim **6** wherein the plurality of contact pads are formed of a ceramic material.

8. The lapping assembly of claim **5** and further comprising a weight applicator plate coupled to the head structure including a ball plunger configured to engage the carrier to bias the carrier and the workpiece toward an abrasive lapping surface.

9. A method comprising:

adjusting, by a gauge block, a relative position of a raised contact surface of a head structure and a carrier for a workpiece, wherein the gauge block is formed of a body having a height that corresponds to a height of the carrier and a gauge thickness of the workpiece; and lapping the workpiece coupled to the carrier until the raised contact surface engages an abrasive lapping surface.

10. The method of claim **9** wherein the step of adjusting the relative position of the raised contact surface and the carrier comprises:

placing the gauge block on adjustable carrier supports on the head structure; and

adjusting an elevation of the adjustable carrier supports so that a front surface of the gauge block is aligned with the raised contact surface.

11. The method of claim **10** and following the step of adjusting the elevation of the carrier supports comprising:

removing the gauge block;

insetting the carrier onto the head structure so that the carrier is supported on the adjusted carrier supports; and

biasing the carrier against the adjusted carrier supports for lapping.

12. The method of claim **11** comprising the step of:

adhering one or more workpieces on a front surface of the carrier for lapping prior to insetting the carrier onto the head structure.

13. A lapping assembly comprising:

a head structure including a raised contact surface; and

an adjustment mechanism configured to incrementally adjust a relative position of the raised contact surface and a workpiece coupled to the head structure,

wherein the workpiece is coupled to the head structure through a carrier supported on one or more adjustable carrier supports coupled to the head structure; and

wherein the adjustment mechanism includes a threaded drive rod operable to move a wedge shaped block to raise and lower the adjustable carrier supports through one or more linkage components.

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